

CLAIMS

1. A method for assessing a safety risk in construction engineering of an existing building, comprising:

creating a finite element model representing a structure of the existing building;

defining a main body of the existing building according to the finite element model, the main body comprising columns, beams and truss rods; and

assessing a safety risk of the existing building using a reserve load strength ratio of the main body,

wherein the reserve load strength ratio of the main body is calculated according to a formula:

$$\varphi = \frac{1}{3} \times (\sum_{i=1}^{N_{\text{column}}} \varphi_i^{\text{column}} w_i^{\text{column}} + \sum_{i=1}^{N_{\text{beam}}} \varphi_i^{\text{beam}} w_i^{\text{beam}} + \sum_{i=1}^{N_{\text{rod}}} \varphi_i^{\text{rod}} w_i^{\text{rod}}),$$

where:

φ is the reserve load strength ratio of the main body of the existing building;

$\varphi_i^{\text{column}}$ represents reserve load strength ratios of the columns;

w_i^{column} represents safety risk weight factors of the columns in the main body of the existing building;

φ_i^{beam} represents reserve load strength ratios of the beams;

w_i^{beam} represents safety risk weight factors of the beams in the main body of the existing building;

φ_i^{rod} represents reserve load strength ratios of the truss rods;

w_i^{rod} represents safety risk weight factors of the truss rods in the main body of the existing building;

i represents the i -th structural member of the columns, the beams and the truss rods in the main body of the existing building and is a natural number greater than 0; and

N is the total number of the columns, the beams and the truss rods in the main body of the existing building and is a natural number greater than 0,

wherein the reserve load strength ratio of each of the columns, the beams and the truss rods is calculated according to the formula:

$$\varphi_i = \frac{\sigma_{pi}^r - \sigma_i^r}{\sigma_{pi}^r - [\sigma_i^r]}$$

where:

φ_i is the reserve load strength ratio;

σ_{pi}^r is an ultimate load strength;

σ_i^r is an actual load strength;

$\sigma_{pi}^r - \sigma_i^r$ is an ultimate reserve load strength;

$[\sigma_i^r]$ is a nominal allowable load strength;

$\sigma_{pi}^r - [\sigma_i^r]$ is a nominal allowable reserve load strength;

r denotes a real structural member;

p denotes an ultimate limit of load strength; and

when $\sigma_i^r < [\sigma_i^r]$, φ_i is equal to 1,

wherein the safety risk weight factor of each of the columns, the beams and the truss rods in the main body of the existing building is calculated according to a formulae:

$$w_i^{\text{column}} = \frac{|\sigma_i^{\text{column}}|}{\sum_{i=1}^N |\sigma_i^{\text{column}}|},$$

where σ_i^{column} is a load strength of an i -th column against an axial force;

$$w_i^{\text{beam}} = \frac{|\sigma_i^{\text{beam}}|}{\sum_{i=1}^N |\sigma_i^{\text{beam}}|},$$

where σ_i^{beam} is a load strength of an i -th beam against a bending moment; and

$$w_i^{\text{rod}} = \frac{|\sigma_i^{\text{rod}}|}{\sum_{i=1}^N |\sigma_i^{\text{rod}}|},$$

where σ_i^{rod} is a load strength of an i -th truss rod against an axial force,

wherein if the reserve load strength ratio of the main body is less than 1, then the existing building is determined to be associated with a safety risk,

which is classified into one of the following classes:

Class I: when $X \leq \varphi < 1$;

Class II: when $Y \leq \varphi < X$; and

Class III: $\varphi < Y$,

where X is a boundary value between Classes I and II, and Y is a boundary value between Classes II and III,

wherein a loading condition and a corresponding load strength of the columns, beams and truss rods in the main body of the existing building are determined through monitoring structural deformation of the existing building in real time, the load strength being reflected in the finite element model, and a structural reanalysis is performed on the existing building using the finite element model to determine a real-time reserve load strength ratio of the main body of the existing building, and

wherein monitoring structural deformation of the existing building comprises monitoring angles of inclinations of walls with respect to a roof truss using an inclinometer, and monitoring displacement of walls relative to the roof truss using a distance sensor.

2. The method for assessing a safety risk in construction engineering of an existing

building according to claim 1, wherein if $X=0.85$ and $Y=0.6$, then the safety risk is classified

into Class I when $0.85 \leq \varphi < 1$, or

into Class II when $0.6 \leq \varphi < 0.86$, or

into Class III when $\varphi < 0.6$.

3. The method for assessing a safety risk in construction engineering of an existing building according to claim 1, wherein if $X=0.8$ and $Y=0.7$, then the safety risk is classified

into Class I when $0.8 \leq \varphi < 1.0$, or

into Class II when $0.7 \leq \varphi < 0.8$, or

into Class III when $\varphi < 0.7$.